Multifunction Electro-Optics for Defense of US Aircraft (MEDUSA)

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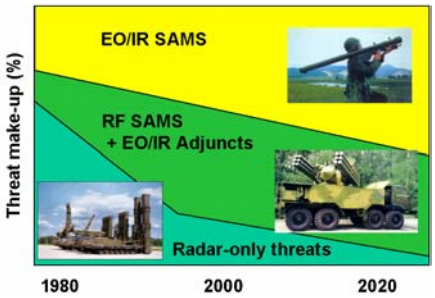
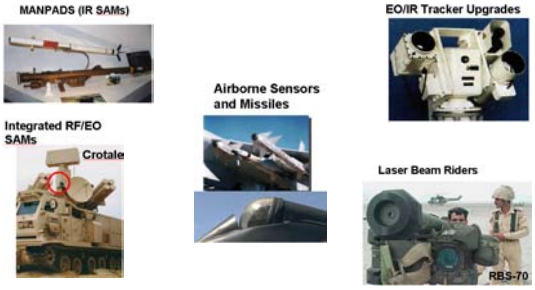
The MEDUSA program addresses the emerging threat of non-RF air defenses. As shown in the following plot, our adversaries are increasingly turning to EO/IR defenses that are RF-silent.



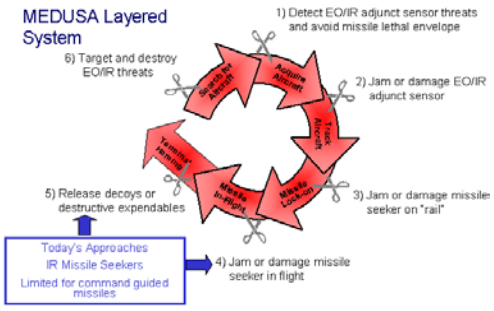
Our program to address this threat is named MEDUSA, after the mythical creature who turned anyone who looked at her into stone. The name was chosen to convey the goal of our program: to take out any enemy air defense system that tracks our aircraft. It takes the paradigm we use to protect our aircraft from radar-guided surface-to-air missiles and applies it to protection against optical and infrared guided missiles. For years we have had ways to find and target the radar trackers that are attempting to lock on and attack our aircraft. MEDUSA will do the same to infrared and optical guided missiles, which are much harder to find since they are often passive.

There are a wide variety of these types of missiles. Some are hand-held with infrared seekers. Some are seekerless and ride a laser beam that is pointed at the aircraft. Some are command guided by a tracking system that uses optics or infrared, perhaps with a radar too. The attribute that they all share is that they all can kill aircraft with little or no use of a radar.



Historically, these threats have been dealt with in relatively passive ways such as dispensing flares. But more often than not, we deal with these threats by avoiding them completely, which limits our freedom in the air.

The MEDUSA program takes a more active approach, searching for these types of threats and dealing with them before they launch or immediately after launch. It combines both active and passive optical systems and includes multiple modes of operation: search, track, classify and optical defeat. The goal is to break the enemy air defense kill chain at multiple points, not just at the endgame.



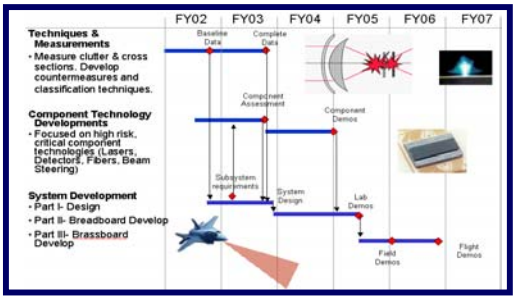
For example, if we can break track and avoid a missile launch, it's far superior to waiting until the missile is seconds away and then jam, jink, or deploy flares while crossing your fingers. It also clears the way for other aircraft in the same strike package. As senior officers at Air Combat Command said, they want to break the enemy air defenses as early in the kill chain as possible and to establish air dominance over the largest envelope of altitudes and locations.

The technical challenges for MEDUSA are to find these systems at long ranges with a low false alarm rate, and to successfully disable the

threats. The program is organized into three concurrent efforts:

1. techniques and measurements;
2. component technology developments, and
3. system development.

There is a critical interplay among the three efforts. The data gathered in the measurements program will drive the system designers. Component technology maturity will determine the menu from which the system designers will choose. System designers will decide which components are most critical to their designs. We are actively encouraging communications among the three parts of the program through workshops and joint program reviews.



The first effort will make a series of measurements and develop techniques that will establish some of the design boundaries for a MEDUSA system. Most of this work will be done by government laboratories and their in-house contractors. There are four main work areas. The first is to measure the characteristics of the systems MEDUSA will be looking for. Included in this will be measurements of the likely operating background clutter. Techniques for distinguishing threats from clutter will be explored and techniques for optically defeating the threats will be developed. These efforts will establish a fundamental knowledge base for the rest of the MEDUSA program. This database will be available to other US government agencies interested in using the data for other programs.

The second major effort is to develop the key component technologies required to build a MEDUSA system. In determining the feasibility of MEDUSA, some key technologies were identified for development. At the top of the list are lasers that could provide enough power at the right wavelengths to give MEDUSA a useful operational range. The analysis points to lasers in the range of 20-30 Watts in the short, medium, and long wave infrared bands, with various pulse formats for the search, classify and countermeasure functions. Detectors to work in a laser radar are also needed. Conventional direct detection techniques are not sufficiently sensitive to detect the few photons that are expected to return from targets, so avalanche photodiodes, optical amplifiers, and coherent detection schemes will be explored. Passive, multi-wavelength infrared detector arrays are also a key enabling component. In addition, there are some technologies required to enable the MEDUSA system to fit on tactical aircraft. To avoid large gimbals that would degrade the aerodynamics and observability of modern aircraft, non-mechanical beam steering techniques that provide large fields of view from a small aperture are needed. Also a need was identified to move large amounts of infrared laser power around an aircraft, using some type of waveguide. To address these technical demands, a Program Research and Development Announcement (PRDA) was published this past fall. Eleven contracts were awarded to various companies to begin work on all of these critical technologies.

The third effort in MEDUSA is to demonstrate a system. Three contracts for a full design effort have been awarded. If the designs look promising and feasible, then a system development and system demonstration will follow. The candidate platforms for MEDUSA are fighter aircraft such as the F-22 and Joint Strike Fighter, although the final demonstration will probably be on a testbed aircraft. While it is assumed that the three contractors in the design phase will be the prime contractors for the development and demonstration phases, there is no assumption about subcontractors or teammates.

MEDUSA will revolutionize how we protect US aircraft. It has plenty of technical challenges, and I am always eager to hear from people who have good ideas to help the program.